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PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

VOL. II. 1849–50. No. 35.

Sixty-Eighth Session.

Monday, 3*d December* 1849.

Hon. Lord MURRAY, V.P., in the Chair.

The following Communication was read:—

1. Personal Observations on Terraces, and other proofs of Changes in the relative Level of Sea and Land in Scandinavia. By Robert Chambers, Esq., F.R.S.E., &c.

In this paper were given descriptions of alluvial formations of a terassiform character in the valley of the Lir river, near Drammen, in Norway, and of similar objects in valleys near the foot of the Miösen lake. The author then described a remarkable terrace which runs for fully fourteen miles at one elevation along the upper part of the valley of the Logan, in the Dovre field. It is composed on the left side of the valley of water-laid sand, and is believed to be about 2150 feet above the level of the sea. On the Dovre field, several hundred feet higher, are morasses containing the remains of much greater trees than are now growing in that district, the highest vegetation of which is a dwarf birch; and Mr Chambers remarks, that when the terrace was on the sea-level this district would enjoy a temperature fit for the production of such large timber. Mr Chambers next described some remarkable terraces in the valleys near Trondhiem, and particularly the great terrace of erosion which overlooks that city at an elevation of 522 feet above the sea.

The remainder of the paper was chiefly devoted to an account of a remarkable couple of terraces, which are traceable along the coasts of Nordlands and Finmark, apparently at one level (57 and 143 feet above the sea), excepting in the sounds near Hammerfest; where, throughout a space of twenty-five miles, they are upon an

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inclination. This portion of the phenomena fell under the attention of M. Bravais, of the French Scientific Expedition of the North, by whom they were measured barometrically and described. The present observer took measurements of these inclined terraces by the level and staff, in eighteen or twenty places, and thus confirmed the views of his predecessor. By Mr Chambers's observations, the following new points are ascertained: 1. The terraces, as being inclined, form an exceptive case, in contrast with those of a neighbouring district of coast of much larger extent (at least 180 geographical miles). 2. The disturbed district has moved on an axis of rest near Nœverfiord, where the two terraces are about the normal height. 3. A line, 14° west of north, (being nearly the line of the magnetic meridian), being drawn across the disturbed district, the inclination is shewn to be equable throughout equal spaces of that line, which is thus proved to be the meridian of the movement. 4. The northern extremity of the dip of the upper line at Hammerfest is 58 feet below, and the southern extremity, abreast of the Alten terraces, is 96 feet above the axis of rest.

The author then described visits which he paid in September 1849 to two of the places in the Gulf of Bothnia where marks have been made in order to detect the rate of movement of the land; at the rock near Löfsgrund he found the sea about six inches below the mark made sixteen years before by Sir Charles Lyell; while, on the cliffs of Grasöe, where Flumen made a mark in 1820, the water was exactly eleven inches lower.

His Grace the Duke of Argyll

was duly elected an Ordinary Fellow.

The following Donations to the Library were announced:—

Address delivered at the Anniversary Meeting of the Geological Society of London, 16th February 1849. By Sir H. de la Bêche. 8vo.—*By the Author.*

Proceedings of the American Philosophical Society. Vol. V., No. 41. 8vo.—*By the Society.*

Journal of the Statistical Society of London. Vol. XII., Pt. 2. 8vo. —*By the Society.*

Scheikundige Onderzoekingen, gedaan in het Laboratorium der Utrechtsche Hoogeschool. 5de Deel, 1ste, 3de, & 4de Stuk. 8vo.—*By the University.*

The American Journal of Science and Arts. Vol. VII., No. 21. 8vo. Edited by Professors Silliman and Dana.—*By the Editors.*

Journal of the Asiatic Society of Bengal. Edited by the Secretaries. New Series, No. 25. 8vo.—*By the Editors.*

Quarterly Journal of the Geological Society of London. No. 16. 8vo.—*By the Society.*

Bulletin de la Société Géologique de France. Tom. XIV., & Tom. I. & II. 2de Série. 8vo.—*By the Society.*

Sixteenth Annual Report of the Royal Cornwall Polytechnic Society, 1848. 8vo.—*By the Society.*

The Journal of Agriculture and Transactions of the Highland and Agricultural Society of Scotland. No. 25, N.S., July 1849. 8vo.—*By the Publishers.*

The Journal of the Royal Geographical Society of London. Vol. XIX., Part 1, 1849. 8vo.—*By the Society.*

Verhandelingen der Eerste Klasse van het K. Nederlandsche Instituut van Wetenschappen, Letterkunde, en Schoone Kunsten te Amsterdam. 3de Reeks, 1sten Deels, 2de Stuk. 4to.

Tijdschrift voor Wis-en Natuurkundige Wetenschappen, uitgegeven door de Eerste Klasse van het K. Nederlandsche Instituut van Wetenschappen, Letterkunde en Schoone Kunsten. 2de Deel, 3^{e} & 4^{e} Afleverings. 8vo.—*By the Institute.*

Report of the Eighteenth Meeting of the British Association for the Advancement of Science, held at Swansea, in August 1848. 8vo.—*By the Association.*

Neue Denkschriften der Allgemeine Schweizerischen Gesellschaft für die gesamten Naturwissenschaften. Bde. 8 & 9. 4to.

Verhandlungen der Schweizerischen Naturforschenden Gesellschaft bei ihrer Versammlung zu Winterthur 1846 & 1847. 8vo.

Mittheilungen der Naturforschenden Gesellschaft in Bern. Nos. 87–134. 8vo.

Die Wichtigsten Momente aus der Geschichte der drei ersten Jahrzende der Schweizerischen Naturforschenden Gesellschaft. 1848. 8vo.—*By the Society.*

Antiquités Celtiques et Antidiluviennes. Mémoire sur l'Industrie primitive et les arts à leur origine. Par M. Boucher de Perthes. 8vo.—*By the Author.*

Meteorologische Beobachtungen angestellt auf Veranstaltung der Naturforschenden Gesellschaft in Zürich. 1837–46. 4to.

Denkschrift zur Feier des hundertjahrigen Stiftung festes der Naturforschenden Gesellschaft in Zürich am 30 November 1846. 4to.—*By the Society.*

Mittheilungen der Naturforschenden Gesellschaft in Zürich. Heft I., (No. 1–13). 8vo.—*By the Society.*

Proceedings of the American Philosophical Society. Vol. V., January, March, 1849. No. 42. 8vo.—*By the Society.*

The Progress of the development of the Law of Storms, and of the Variable Winds, with the practical application of the subject to Navigation. By Lieut.-Colonel William Reid. 8vo.—*By the Author.*

On the Geological Structure of the Alps, Apennines, and Carpathians, more especially to prove a transition from Secondary to Tertiary Rocks, and the development of Eocene Deposits in Southern Europe. By Sir Roderick Impey Murchison. 8vo.—*By the Author.*

Account of the effect of a Storm on Sea-Walls or Bulwarks on the coast near Edinburgh, as illustrating the principle of the construction of Sea-Defences. By W. M. Rankine. 8vo.

An Equation between the Temperature and the maximum elasticity of Steam and other vapours. By W. M. Rankine. 8vo.—*By the Author.*

The American Journal of Science and Arts. Conducted by Professors Silliman and Dana. 2d Series, No. 22, July 1849. 8vo.—*By the Editors.*

Journal of the Asiatic Society of Bengal. Edited by the Secretaries. No. 200, February 1849. 8vo, and N.S., No. 28, April 1849, and No. 203.—*By the Editors.*

Journal of the Statistical Society of London. Vol. XII., Parts 3 and 4. 8vo.—*By the Society.*

Journal of the Geological Society of Dublin. Vol. IV., Part 1. 8vo.—*By the Society.*

Catalogue of the Calcutta Public Library. 8vo.—*By the Council.*

Flora Batava. 159 Aflevering. 4to.—*By the King of Holland.*

A Letter addressed to the Earl of Rosse, President-Elect of the Royal Society. By Marshall Hall, M.D. 8vo.

On the Neck as a Medical Region, and on Trachelismus ; on Hidden Seizures ; on Paroxysmal Apoplexy, Paralysis, Mania, Syncope, &c. By Marshall Hall, M.D. 8vo.—*By the Author.*

Astronomical Observations made at the Radcliffe Observatory. By Manuel J. Johnson. 1842, 1843, 1844, 1845, 1846, 1847. Vol. III.—VIII. 8vo.—*By the Radcliffe Trustees.*

Quarterly Journal of the Geological Society. No. 18, 1849. 8vo. —*By the Society.*

Journal of the Indian Archipelago and Eastern Asia. Vol. III. Nos. 1, 2, 3, 4. 8vo.—*By the Editor.*

The American Journal of Science and Arts. Conducted by Professors Silliman and Dana. Second Series. No. 23. 8vo.—*By the Editors.*

Memoirs of the Ganglia and Nerves of the Uterus. By Robert Lee, M.D. 4to.

On the Ganglia and Nerves of the Heart. By Robert Lee, M.D. 4to.—*By the Author.*

Athenæum. Rules and Regulations, List of Members, &c. 1847. 12mo.

——— Annual Report—General Abstract of Accounts. 1848.—*By the Athenæum.*

Description of a Machine for Polishing Specula, with Directions for its use. By W. Lassell, Esq. 4to.—*By the Author.*

Monday, 17th December 1849.

Right Rev. Bishop TERROT, V.P., in the Chair.

The following Communications were read :—

1. Note respecting the Dimensions and Refracting Power of the Eye.* By Professor J. D. Forbes.

"Whilst lecturing lately on the subject of Vision, I consulted some recent authorities on the dimensions and curvatures of the refracting apparatus of the eye; and having calculated from them the convergence of rays within the eye, it may save trouble to others to put them on record.

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"The measures of the eye given in almost every English work on the subject, are those given by Young on his own authority, or that of Petit. In the fifth volume of Dove's Repertorium, I find a series of measures collected by Treviranus from his own and preceding observations, which I have converted below from French lines into decimals of an English inch. In these the curvatures are supposed spherical. In the same work of Dove, I find a series of measures by Dr Krause of Hanover, on eight recent human eyes, which seem to have been made with uncommon care, and in which the deviation of the surfaces from sphericity is noticed. I have preferred these last for the purpose of calculation, because *all* the measures are taken from the same eye, which is not the case with the numbers collected by Treviranus. I have consulted the original paper of Krause in Poggendorff's Annalen, vols. xxxi. and xxxix., where it appears, (1.) That the cornea is thicker at the sides than in the centre; (2.) The anterior curve of the cornea is nearly spherical, the posterior parabolic; (3.) The anterior surface of the lens is elliptical, the lesser diameter being in the axis of vision, the posterior surface is parabolic; (4.) The figure of the retina, or the posterior surface of the vitreous humour, is an ellipsoid.

"The following are those given by two eminent German authorities, Treviranus and Krause, when reduced to English inches:—

	Mean of several Authors by Treviranus.	Mean of eight measures by Krause.
	Inches.	Inches.
Thickness of cornea (central part), .	0·032	0·040
Distance of first surface of lens from back surface of cornea, . . .	0·104	0·107
Pupil behind cornea, . . .	0·096	0·083
Thickness of lens, . . .	0·181	0·181
Axis of vitreous humour, . .	0·548	0·567
Axis of the eye from interior of the cornea to the retina, ...	0.833	0·855
Radius of first surface of cornea, .	0·301	0·348
Radius of first surface of lens, . .	0·280	0·369
——— of second do., . . .	0·196	0·201
Curvature of retina near the axis, .	0·534	0·523

These numbers agree tolerably well, only that the radius of curvature of the first surface of the lens is disproportionately great in the last column. This arises from the circumstance, that it is derived by calculation, for the curvature of an ellipse at the lesser axis, the two axes of which are alone given by Krause. Now, it is evident, that if we regard the lens *as a whole*, or even any considerable breadth of it, its mean radius of curvature will be sensibly smaller. In fact, Krause finds that it may be tolerably represented by a circular curvature, having a radius of ·329 inches. It occurred to me, however, that by taking the *greatest* density of the lens, as given by Brewster, and the curvature of the middle part, both anterior and posterior, as given by Krause, I ought to arrive at a close approximation to the course of the axial pencil.

"I have adopted for the refractive indices of the parts of the eye, those given by Sir D. Brewster in his original paper in the Edinburgh Philosophical Journal, vol. i., page 44, with the exception of that of the densest part of the lens, which is almost certainly misprinted. They are as follow :—

Aqueous humour, . . .	1·3366 $= \mu_1$
Crystalline, outer coats, . .	1·3767
——— middle coats, . .	1·3786
——— central coats, . .	1·3990*$= \mu_2$
——— the whole, . .	1·3839
Vitreous humour, . . .	1·3394 $= \mu_3$

"Calculating from the preceding data, with Sir D. Brewster's indices of refraction, the author finds the positions of the foci, towards which the rays converge, after refraction at the successive surfaces, to be the following (reckoning from the *interior* surface of the cornea, the thickness of which has been neglected)—

	For rays falling parallel on the cornea. Inches.	For rays diverging from a point 10 inches distant. Inches.
After first refraction at the aqueous humour, . . .	= 1·382	1·541
After second refraction at first surface of the lens, . .	= 1·260	1·377
After third refraction into vitreous humour, . . .	= 1·060	1·135

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* In the Edinburgh Phil. Journ., we find 1·3999. But I take this to be a misprint, as in Sir D. Brewster's own subsequent writings, we always find 1·3990.

"Now the measure of the axis of the eye we have seen to be only ·833 inch, according to Treviranus, and ·855 according to Krause; consequently, rays of mean refrangibility (to which Brewster's measures refer) converge to a point no less than ·227 inch behind the retina, when the rays fall parallel on the cornea, and ·302 when the object viewed is at 10 inches' distance. The axis of the eye, as even measured by Dr Young, though somewhat greater than we have reckoned it above, (Dr Young makes it ·91), does not come up to the requisite dimensions; and Dr Young, with his usual acuteness, ascribes the difference to the gradually varying density of the strata or coats of the lens,* the dense small nucleus evidently acting as a lens of comparatively short focus; and this explanation is probably the correct one, to which we may add, that the configuration of the coats of equal density, which, near the surface of the lens, are very elliptical, become, near its centre, gradually nearly spherical. On this account, it is all but impossible to predict the exact course of the rays through a structure of so much complication.

"Dr Young had considered the case with his usual attention and penetration. He investigates the focus of a spherical lens, or lens with surfaces which are segments of spheres, and whose density is variable, and the result may be recalled here as one which, perhaps, has not been sufficiently remarked. "On the whole," he says, "it is probable that the refractive power of the human crystalline in its living state is to that of water nearly as 18 to 17 [gives index refr. = 1·415]; that the water imbibed after death from the humour of the capsule reduces it to the ratio of 21 to 20 [1·403], but that, on account of the unequable density of the lens, its effect on the eye is equivalent to a refraction of 14 to 13 [1·439] for its whole size."†

"On the whole, these calculations, as well as the considerations into which I entered in a former paper, read to the Society in 1844,‡ on the mechanism of the focal adjustment, have left on my mind the conviction that the optical and mechanical structure of the organ of sight is even less understood than it is commonly believed to be. Simple as are its general arrangements, and comparable, in some respects, to those of artificial combinations, we perceive surfaces figured in a complex manner, and structures of varying refractive density combined in a very complicated manner. Krause's measures of the curvature of the surfaces of the lens confirm the inadmissibility of the all but universal opinion of the variation of density of the crystalline being intended to correct the aberration of spherical surfaces, when, in reality, no such surfaces exist. We are quite unable to trace the exact course by which the rays of light are focalised on the retina, since it depends on the internal constitution of the lens that they do not meet very far behind it; and it still remains at least doubtful how the adjustment to distinct vision of objects at different distances is effected.

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* Nat. Phil., vol. ii., p. 580.

† Nat. Phil., vol. ii., p. 82.

‡ Transactions Royal Society of Edinburgh, vol. xvi., p. 1.

"Finally, the question of achromatism of the eye has its own difficulties. It is not now contended that the eye has the power of converging equally rays of different refrangibilities; but it is not unreasonable to suppose that the chromatic aberration is at least partially corrected. One result of the calculations into which I have entered (which were first in part undertaken at my request, by Mr James Clerk Maxwell, and since entirely repeated and extended by myself), is a clear exhibition of the physical conditions of perfect achromatism in the eye. The form is simpler than I have elsewhere seen, and may at once satisfy any reasonable person of the possibility that the eye might be rendered achromatic, at least for objects at a certain distance; to prove which, so much has been written, and at so great length. The result may be stated in two lines. If we calculate the effect upon the *final* focal distance of the whole refracting system of the eye (q''), of a variation in the refractive index of each of its three humours (denoted by μ_2, μ_3, μ_4). We find this equation when the incident rays are parallel, or reach the eye from a very distant object:—

$$\delta q'' = 1{\cdot}579\ \delta\mu_2 + 1{\cdot}150\ \delta\mu_3 - 2{\cdot}788\ \delta\mu_4.$$

Let the coefficients $\delta\mu_2$, $\delta\mu_3$, $\delta\mu_4$ denote the dispersion or differences of the indices of refraction for extreme rays, corresponding to the three media, then it is evident, from the negative sign of the third term on the right hand, that they may be so chosen as to annihilate the second side of the equation, or make the variation of focal distances *nothing*, for the differently refrangible rays.

"If the rays proceed from a point 10 inches distant from the eye, the equation for the variation of the focus will be

$$\delta q'' = 1{\cdot}873\ \delta\mu_2 + 1{\cdot}402\ \delta\mu_3 - 3{\cdot}298\ \delta\mu_4$$

and the condition which makes this equal to zero, or the focus independent of small variation of the refrangibility of the ray may be satisfied, at the same time that the former equation is satisfied also; consequently, *with three media, as in the eye, we may have perfect achromatism for any two distances;* which would also be sensibly perfect for the intervening ones. Of course by perfect achromatism, we here mean a union of the extreme red and violet rays; the *irrationality* of dispersion does not concern this question."

2. On the Intensity of Heat reflected from Glass. By Professor J. D. Forbes.

The author, after referring to a communication made to this Society, on the 18th March 1839, on this subject, and noticed in the "Proceedings" of that date, stated, that being about to recommence his observations on radiant heat, so long and unavoidably interrupted, he had carefully examined the unpublished observations on which the previous notice was founded, with a view to ascertain what might be the numerical discrepancy which they present from Fresnel's Theoretical Law. The variation in the results of experiment for each of the angles was very considerable, arising from a multitude of causes as yet imperfectly estimated, but which appear to have been encountered by other observers, who, since that time, have undertaken the same research. Under the circumstances, the mean of the whole observations made between November 1838 and March 1839, have been taken for each angle of incidence; and the results being projected in the usual manner, the angles of incidence forming the line of abscissæ, and the intensities the ordinates, an interpolating curve was drawn through the whole. The numbers thus obtained (which are presented as only a rude first approximation), are shewn in the following table, and compared with Fresnel's Formula, calculated for an index of refraction of 1·50.

Incidence.	Proportion of Heat Reflected.	Fresnel's Numbers, when $\mu = 1·50$.
0°	·038	·040
10	·040	·040
20	·044	·040
30	·051	·042

Incidence.		Proportion of Heat Reflected.		Fresnel's Numbers, when $\mu = 1{\cdot}50$.
40°	......	·060	......	·046
50	......	·076	......	·058
60	......	·105	......	·089
70	......	·185	......	·171
80	......	·433	......	·388
85	......	·68	......	·613
90	......	1·00	......	1·000

The results of experiment are generally in excess. This may be due to the impossibility of obtaining rays of heat quite parallel from terrestrial sources. To avoid this and other difficulties, experiments have recently been made in Germany by M. Knoblauch, and in Paris by MM. Provostaye and Depains. The results of the last named observers are very conclusive in favour of the accuracy of Fresnel's law. Their memoir had not reached the author of this paper until his calculations were almost completed.

3. On the solution of certain Differential Equations. By Professor Kelland.

Until recently, general solutions of several classes of equations, such as that which occurs in the theory of the figure of the earth, could not be arrived at. An ingenious transformation lately rendered it a matter of comparative ease to arrive at a solution of these equations in those forms in which they are presented in the solution of physical problems; but still much remains to be done. The object of the present paper is to supply some portion of the deficiency in this respect, by the introduction of a new transformation, and the adoption of the function Γ. The solutions thus obtained are perfectly general, and are arrived at with the greatest facility.

The Most Noble the MARQUIS OF TWEEDDALE

was duly elected an Ordinary Fellow.

The following Donations to the Library were announced:—

The Astronomical Journal. Vol. I., No. 1. 4to.—*By the Editor.*

Athenæum—Annual Report—General Abstract of Accounts from 1st January to 31st December 1848. 8vo.—*By the Athenæum.*

Twenty-Ninth Report of the Council of the Leeds Philosophical and Literary Society. 1848–49. 8vo.—*By the Society.*

Smithsonian Contributions to Knowledge. Vol. I. Published by the Smithsonian Institution. 4to.

Report, &c. of Smithsonian Institution. 1849. 8vo.—*By the Institution.*

Fauna Antiqua Sivalensis, being the Fossil Zoology of the Sewalik Hills, in the North of India. By Hugh Falconer, M.D., and Proby T. Cautley, F.G.S. Parts I. and IX. Fol.

Do. do. Letter-Press. Part I. 8vo.—*By the Author.*

United States Exploring Expedition during the years 1838, 1839, 1840, 1841, and 1842, under the command of Charles Wilkes, U.S.N. Atlas. Zoophytes. By James D. Dana, A.M. Imp. Fol.—*By the Author.*

Astronomical Observations made at the Royal Observatory, Greenwich, in the year 1847, under the direction of George B. Airy, Esq. 4to.—*By the Observatory.*

Philosophical Transactions of the Royal Society of London for the year 1849. Parts I. and II. 4to.

List of Fellows, &c. of the Royal Society, 30th November 1848. 4to.

Proceedings of the Royal Society. 1848. Nos. 71 and 72. 8vo. *By the Society.*

Monday, 7th January 1850.

Sir THOMAS M. BRISBANE, President, in the Chair.

The following Communications were read:—

1. On the Muscular Substance of the Tongue. By Mr Zaglus. Communicated by Professor Goodsir.

Professor Goodsir communicated an abstract of a paper by Mr Zaglus on the muscular structure of the tongue. The author of the paper had found the muscular substance of the tongue to consist of a cortical layer, which surrounds the organ on all sides, except its posterior attachment, and in the middle line of its inferior surface.

The cortex consists of a complicated network of fibres, derived from the hyoglossi, styloglossi, lingualis, chondroglossi, and a pair of new muscles, named by the author Notoglossi. The minute details of the arrangement of these muscles have now been ascertained by the author, and their actions in producing the peculiar volubility of the organ.

The cavity of the cortex is occupied by a medulla of transverse and perpendicular muscles, some of which are limited to the cavity itself; others pass into it from without.

The transverse system consists of transversales proprii, with the palatoglossi and glossopharyngei, the perpendicular of external or proper, perpendicular muscles, and internal or geneoglossi.

The transverse and perpendicular muscles are arranged in the medulla, in transversely parallel laminæ, which consist alternately of perpendicular and transverse systems, which pass through the muscles of the cortex to the mucous membrane.

It was also stated, that the human tongue and the ruminant form two types, the latter presenting root, body, and tip, the former wanting the tip. These two types, also, differ in the former possessing, and the latter wanting, a mesial fibro-cartilaginous septum.

2. On the Volcanic Formations of the Alban Hills, near Rome. By Professor J. D. Forbes.

The author thus sums up the general results of his memoir:—

"In the first place, it appears that the Alban volcano (for it is essentially one) has acted throughout a great period of time; for not only has it evidently repeatedly changed its form and materials of eruption, but it is surrounded by knolls of basaltic formations which seem to indicate very ancient and very repeated ejections, without taking the regular form of craters. Such are probably Monte Algido, Civita Lavinia, Monte Giove (Corioli), the Capuccini of Albano, Rocca Priore, Colonna, and perhaps even Capo di Bove, and several open craters, such as one a little below Albano, the Lago Cornufelle near Frascati, the Lake of Gabii, and one near Colonna, which, on the authority of Ponzi, appear to have ejected peperino. The horse-shoe form of the old crater of the Alban Mount, which, whether formed by the elevation process or not, appears to be composed of beds of basalt, lapilli, tuff, or peperino, and here and there of the lava called *Sperone*, gave way, like that of Somma, on the western or seaward side, and I cannot but think it in no small degree probable, that the vast lava beds which lie under Nemi and Genzano, and which dip at a small angle under Monte Cavo, are part of the dislocated walls of the ancient crater displaced by the convulsion which rent it on the western side, and which was accompanied by a prodigious fluid discharge of peperino, which then formed the strata of La Riccia and Albano, and which, overwhelming the broken-down wall of the ancient crater, formed at the same time the Monte Gentile, and the peperino beds above Nemi. This is confirmed by the prodigious lava blocks imbedded in these rocks, which bespeak the violence of the convulsion during which they were formed. Ages later, the present summit of Monte Cavo and the crater of the Campo d'Annibale were formed, and the latter gave out its currents of *tefrine* or grey basalt, and raised the crater of La Tartaruga and others in the valley of La Molara, and in the central crater; at the same time ejecting great volumes of pulverulent lapilli. It may have been coeval with these perfectly regular and comparatively modern eruptions, or it may have preceded them, that, after a period so long that the surface of the ancient eruptions of peperino were covered with vegetation and timber, the tremendous outbursts which forced open the craters of Albano and Nemi took place, the former producing some slight ejections of peperino or boiling mud, near Castel Gaudolfo; and at the same time a separate orifice, opening at the foot of Monte Cavo, may have discharged into the valley of Marino the remarkable variety of peperino described in this paper, and containing vegetable stems. A long, perhaps even a final, repose succeeded this paroxysm. Even from the very dawn of Italian history these scenes of previous turmoil and desolation appear to have enjoyed profound tranquillity, and to have been immemorially covered with impenetrable groves sacred to the sports of Diana.

"It will be seen, then, that we admit tufas or peperinos of three very different periods, one of which is coeval with, or even anterior to, the formation of the exterior cone, another largely developed, which accompanied the great breach in it towards the sea; and a third, which probably produced some local streams, such as that of Marino, which has evidently flowed since the ground took its present configuration, and was covered with plants. Of lavas, likewise, we must admit at least three periods; 1*st*, the compact basalts of the outer circuit, which, if Von Buch's theory be correct, have flowed under a less inclination than they at present have; 2*dly*, The well-marked leucitic, or partridge-eyed lavas, which form the interior circuit; and, 3*dly*, the compact basaltic lava which flows past Rocca di Papa towards Grotta Ferrata, which is possibly coeval with the dikes occurring at Capo di Bove and elsewhere. This leaves the origin of the *lava sperone* still uncertain. It is undoubtedly one of the more recent products, for it not only overlies the whole of the old basaltic series at Tusculum and Nemi, but the leucitic lavas of the newer cone at Rocca di Papa. The easiest solution would be to consider it as a scoriform basalt; but even to this there are difficulties, not only mineralogical, but from position. For how can we connect the mantle-shaped covering of Monte Cavo up to its highest point, with the basalt, which nowhere attains a height (so far as I know) within several hundred feet of it? It is still more difficult to conceive any continuity between the sperone of the central cone and that of Tusculum, which is separated from it by the great valley of La Molara.

The following gentleman was duly elected an Ordinary Fellow:—

W. J. M. Rankine, Esq., C.E.

The following Donations to the Library were announced:—

The Phenomena Diosemeia of Aratus, translated into English verse, with Notes. By John Lamb, D.D. 8vo.—*By the Author.*

Abstract of Exposition on the Strength of Materials. Read before the Royal Scottish Society of Arts at the request of the Council. By George Buchanan, F.R.S.E. 8vo.—*By the Author.*

Sopra alcuni punti della Teoria del Moto dei Liquidi. Memoria del Prof. P. Tardy. 4to.—*By the Author.*

Annalen der K. Sternwarte bei München, herausg. von Dr J. Lamont. Bde. 1 & 2. 8vo.—*By the Observatory.*

Journal of the Asiatic Society of Bengal. Edited by the Secretaries. Nos. 204 and 205. 8vo.—*By the Editors.*

Journal of Agriculture and Transactions of the Highland and Agricultural Society of Scotland. No. 27, N. S., January. 8vo. —*By the Society.*

Mémoires de l'Académie R. des Sciences, &c. de Belgique. Tom. XXVIII. 4to.

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